Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/203
UNITED STATES
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

DEVELOPMENTS IN PRESSURIZED WATER REACTORS

Woodrow E. Johnson (Westinghouse Electric Corp. - Atomic Power Division)

Since 1958, new generating capacity of 475 MWe has operated in a highly successful manner, 520 MWe is now under construction, another 1375 MWe is committed for operation before 1968, and a 1000 MWe unit will be available for 1970 operation. These units are reviewed and design features are compared. Developments in systems, components and manufacturing are reviewed in light of the effects on increase in rating and reduction in power costs. The radial peak to average power distribution generally expressed as F_T or $F_{\Delta H}$ which in the original Yankee design was set at 3.34 has been reduced through in-core measurements to determine actual operating margins and through cycled core designs as well as the demonstration and application of soluble chemical controls. For designs now underway an $F_{\Delta H}$ of 2.1 is being used with encouraging indications that additional reductions can be obtained. Modular or standardized loop and component designs are available in sizes that permit three to four fold increase in rating yet without change in the number of components. In other words, a Yankee plant could now be built in a single loop, that is, one steam generator and one pump. Reactor coolant pumps of about 65 000 gallons per minute rating and steam generators containing up to 30 000 sq. ft. of heat transfer surface are available. Reactor vessels up to about 200 inches in inside diameter suitable for cores up to about 13 feet in diameter are now considered feasible. Additional work is indicated to establish appropriate fuel management and reactivity control techniques for cores of this size. Improved fuel assembly mechanical designs tested in the Saxton experimental reactor are discussed.

System layout is being continually evaluated to reduce the reactor coolant volume and hence the stored energy which determines the design of the reactor containment system. Extensive work has been carried on to develop and demonstrate the adequacy of reinforced concrete containment systems which provide direct radiation shielding and for restricted sites double containment for stringent leakage control. The concepts of safety injection in which water is rapidly returned to the reactor vessel in the event of a loss of coolant are being developed and applied.

Progress in the design of large 1800 rpm turbine-generator designs including the application of live steam reheat between the high and low pressure turbine elements have kept the technology of the turbine electric plant in step with the size and performance requirements of the nuclear systems. The application of live steam reheat along with other cycle improvements has brought the heat rates of these machines down to about 10 000 Btu's/kwhr.

Experience with, and designs of, system safety features and engineered safeguards are examined. Siting requirements and designs to meet them are reviewed. Possibilities for further improvements, notably cost reduction without sacrifice of safety, are discussed.

The author reviews typical AEC and industry sponsored programs and illustrates the ease with which such developments as "chemical shim" (the use of neutron absorber dissolved in the reactor coolant) have been incorporated into existing as well as new designs. Predictions of the future of PWR are made, including the possibilities of using super critical rates.